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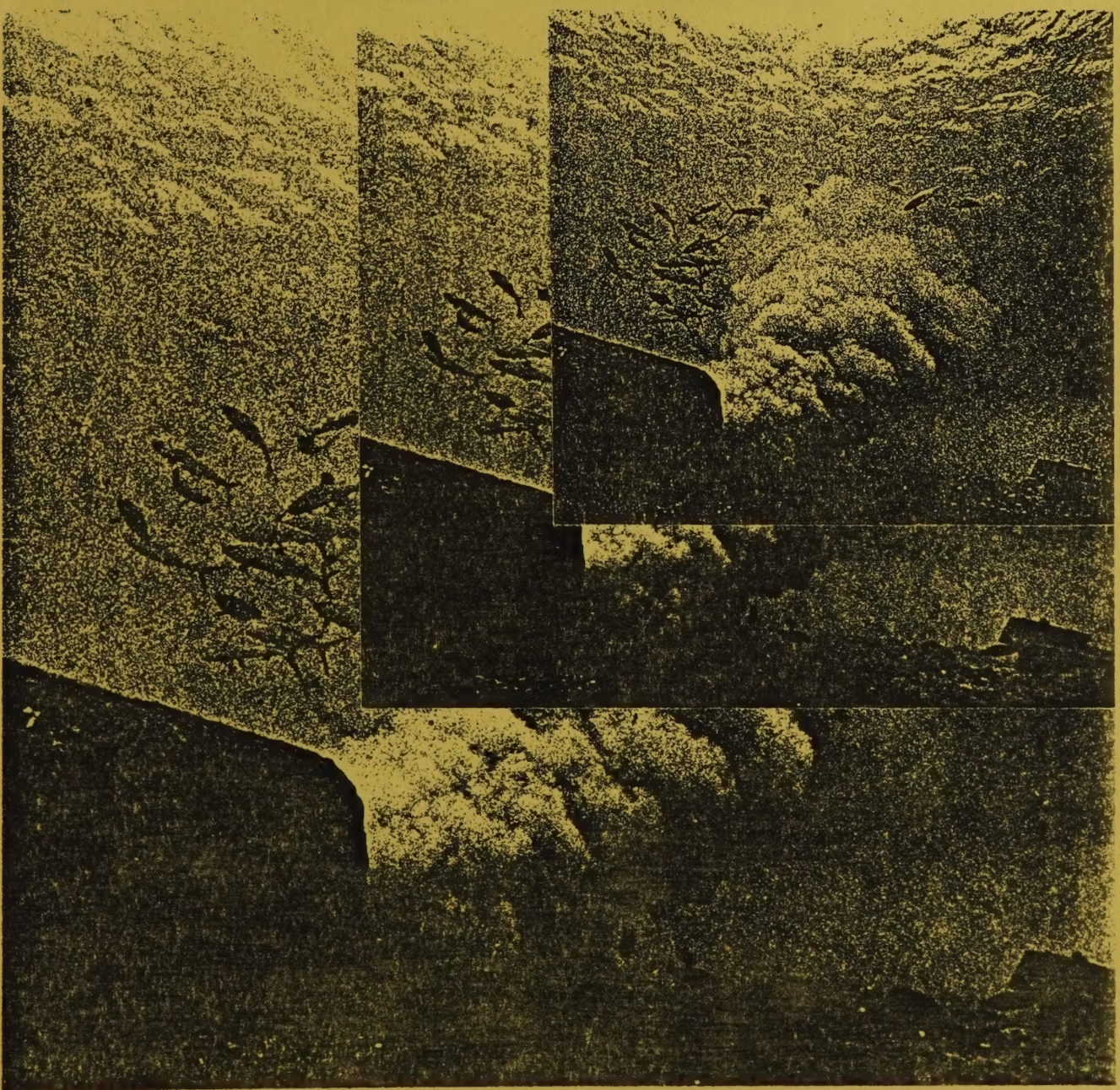
Recommendations for a Five-Year Scientific Investigation on the Marine Resources and Environment of the Main Hawaiian Islands



RECOMMENDATIONS FOR A FIVE-YEAR SCIENTIFIC INVESTIGATION ON THE MARINE RESOURCES AND ENVIRONMENT OF THE MAIN HAWAIIAN ISLANDS

December 1987

PREFACE

This planning document was prepared at the request of Mr. William W. Paty, Director, Hawaii Department of Land and Natural Resources. Mr. Richard S. Shomura, National Marine Fisheries Service, and Dr. Richard W. Grigg, University of Hawaii, also have been instrumental in leading this planning effort.

The recommendations contained in this document represent the personal contributions of the participants in the planning sessions and do not necessarily represent positions of the agencies with which these people are associated.

The participants in the planning process are listed in Appendix A, and the entire planning process is described by Pooley (in prep.).

EXECUTIVE SUMMARY

Need for Research

This report presents recommendations for a 5-yr scientific research initiative directed toward the living marine resources and marine environment of the main Hawaiian Islands. The recommendations were compiled by a group of scientists, concerned with these issues, who met for several days in November and December 1987 (Appendix A).

Tremendous changes are occurring in the living marine resources and marine environment of the main Hawaiian Islands, but a scientific understanding of those changes and the scientific information on which to propose improvements in resource management and habitat conservation are inadequate. These changes are described briefly in Section I of this report and more completely in a companion report (Shomura 1987).

A general conclusion drawn from comparison of the past and present is that there is an urgent need to examine the current status of the marine fishery resources in the main Hawaiian Islands waters. The dramatic decline of reported catch of coastal species may be attributed to shortcomings in the current reporting system or to changes in fishing practices and target species. However, there also is a strong possibility that overfishing and environmental changes are important causes. Management decisions will depend greatly on identifying the major causative factors leading to these changes in the coastal marine resources of Hawaii.

The scientific research proposed by this plan should contribute to a higher level of living marine resource management in the main Hawaiian Islands. These studies also should contribute to other planning processes which currently are addressing ocean use and coastal management in Hawaii. The result of these investigations, besides increasing scientific understanding, should improve the quality of life for Hawaii's people and help resolve a number of current conflicts over the use of Hawaii's marine resources and environment.

Goals and Activities

This report represents the start of a 5-yr scientific research initiative. **The goals of this research initiative are to:**

I. Understand the basic biology and productivity of important living marine resources, particularly fishery resources;

II. Determine the impact of human activity and natural changes on the marine environment and living marine resources; and

III. Develop management strategies for conserving and enhancing important living marine resources.

These goals are described in further detail in Section II of this report. To achieve these goals, a wide range of research activities will be required. Section III of this report identifies these research fields.

Although it is premature to map out fully the precise nature of the research plan, early in the research process it will be important to identify the key biological problems which will motivate, and constrain, the research program. At the same time, development of basic data sources on environmental and living marine resource and preparation of an ocean ecosystem model are important contributions to the rest of the research initiative.

Then a number of studies on living marine resource "life processes" will be undertaken to meet the overall objectives of Goal I. These studies include investigating basic life-history information, developing a food web model, and ultimately determining the overall population structure of important living marine resources.

The next step in the research initiative is to understand the changes which have occurred in living marine resource abundance and in marine environments, i.e., to meet Goal II. This will include studies on the impact of fisheries, pollution, coastal development, and natural disturbances to the marine environment. These studies form the basis for making an overall evaluation of the impact of human changes to our ocean resources, developing a resource management model, and evaluating alternative strategies for conserving and enhancing these living marine resources and the marine environment (Goal III).

Planning Process and Research Time Scale

The overall perspective is one of a collaborative research initiative in which the major State, Federal, University, and private research agencies of Hawaii, along with participation from the public, prepare a cooperative research plan to address specific issues on Hawaii's marine resources and environment. This report is oriented toward scientific issues and problems which need to be addressed in such an initiative. Section IV of this report outlines the planning process and the research plan. An important issue will be the organization of the cooperative nature of the research initiative, and resolution of this issue has been left to the political process and the agencies, organizations, and individuals who agree to cooperate in its implementation.

Any research initiative requires funding, usually funding beyond the base levels at which agencies are currently operating, and this initiative is no different. However, funding requests will be made by the individual agencies participating in this research initiative, and no attempt has been made to estimate the overall cost. What is also required is a **cooperative** relationship among the participating agencies and the public, and a strong **public mandate** for this research initiative. Undoubtedly, new management

measures and attempts at habitat enhancement will change some of the ways we approach Hawaii's living marine resources and marine environment. This report represents the opening dialogue from the scientific community which urges a cooperative and informed approach toward these issues.

The research program will begin as a 5-yr initiative which will include public participation in framing issue-oriented studies and in responding to management recommendations. Several symposia are recommended to present the results of the research projects. Separate reports may also be given to resource management agencies. The program will also involve an ongoing process of resource monitoring. These ideas are outlined in Figure 6 of this report.

INTRODUCTION

This report proposes a cooperative research initiative on the marine resources and marine environment of the main Hawaiian Islands (MHI). The document represents the consensus of a group of scientists who were called together to map out a research initiative that would provide a thorough base line of information on Hawaii's living marine resources and undertake issue-oriented analyses.

This document is organized in the following order:

I. Issues--why a study is recommended.

II. Goals and objectives--what the scientific group concluded are important research goals.

III. Activities--what kind of research can be mounted to meet these goals and objectives.

IV. Program planning--how the issues can be approached.

This planning document is one of four reports developed as part of this research initiative. The planning process is described in a forthcoming Southwest Fisheries Center Administrative Report (Pooley in prep.), and the research problem is described in more detail by Shomura (1987). The research initiative will also involve asking for public input through a mail survey.

I. Issues of marine resources and the marine environment.

"Fishing is not what it used to be" is a common complaint heard today throughout Hawaii. Similarly, there are increasing complaints about the quality of Hawaii's marine environment, and there are increasing reports of conflicts in the use of the ocean area surrounding Hawaii. While there are a number of studies being proposed concerning the management of user group conflict, there has been too little scientific study of the basic living marine resources and marine environment of the MHI.

Hawaii has a seafood consumption rate that is at least twice as high as the national annual average (12.8 lb per capita) (Hudgins 1980; Cooper and Pooley 1982). It is estimated that one-third of Hawaii's seafood comes from domestic (local) commercial fishing sources (Cooper and Pooley 1982) and a large additional amount is consumed from the "recreational" fishery (Meyer 1987). Therefore, any drastic change in the abundance or availability of domestic fishery resources would be a major concern to the people of Hawaii.

Despite the importance of seafood to the people of Hawaii, only a few scientific studies have been directed toward an assessment of the fishery resources in the Hawaiian Islands. Until recently, this deficiency has been due to the lack of adequate analytical techniques to assess tropical fish populations (Polovina and Ralston 1987). However, some studies are available. Ralston (1980) analyzed available data on the bottom fish complex in Hawaiian waters and concluded that some of the species are being

harvested near their maximum sustainable yield. The Hawaii Cooperative Fishery Research Unit of the University of Hawaii has also produced a range of studies on individual species and trophic modeling. Other studies include a number directed toward the lobster resources of the Northwestern Hawaiian Islands (NWHI) (Polovina and Tagami 1979; Uchida et al. 1980; MacDonald 1984), preliminary investigations of nearshore fisheries (Okamoto and Kanenaka 1984), and trophic studies that were part of the NWHI resource investigations (Grigg et al. 1984; Parrish et al. 1984; Polovina 1984). Finally, the nehu population in Pearl Harbor has been estimated by Somerton (pers. commun.) of the Honolulu Laboratory with an egg production technique which may be applicable to other nearshore species.

In addition to the suspected fishery impact on marine resources, it is expected that environmental changes and the discharge of human-generated wastes into the coastal waters of Hawaii may have a major influence on the coastal biota. It is possible that environmental changes and discharge of human-generated wastes into coastal waters are major and, in some cases, the primary, determinants of population dynamics of coastal biota. However, such influences are frequently difficult to quantify: Complex environmental interrelationships generally are not amenable to application of summary statistics such as catch per unit effort. Instead, long-term studies are needed on variation of species and community distributions in response to known environmental perturbations. One of the most comprehensive of these studies was undertaken in Kaneohe Bay (Smith et al. 1981) using extensive historical records of the bay collected by Devaney et al. (1982). Results of that study clearly documented effects on coral reef habitats in the bay from long-term waste discharge and pollution resulting from expanding human activities.

Unfortunately, most environmental changes occur so gradually that they do not evoke dramatic short-term responses within marine biota. Furthermore, impacts to marine communities may be cumulative and thus may not become apparent within a time frame that readily corresponds to observed environmental events. As a result, correlations between environmental change and declines in marine resources require deliberate documentation. There are a number of areas in Hawaii where an extensive environmental data base has been generated over a sufficient interval to be applicable to marine resource impact analyses. Examples include the Kahe Point region on Oahu which was extensively described over a number of years in the course of ocean thermal energy conversion (OTEC) studies (for a summary of Kahe Point OTEC studies, see Harrison (1987)) and the oceanic region in the vicinity of Keahole Point which has been the focus of both published and ongoing investigations (e.g., Noda et al. 1982; Lobel and Robinson 1985).

Although at present, relatively little is known about interactions between environmental changes and Hawaiian marine biota, studies undertaken in other areas provide valuable reference information for assessing a variety of environmental effects on fishery resources. For example, Mendelssohn (1986) discusses sea surface temperature fluctuations in the vicinity of the West African coast and their effect on yellowfin tuna fisheries in the region. Nutrient dynamics and ecosystem responses to changes in nutrient subsidies are examined in a wide range of locations in the volume edited by Neilson and Cronin (1981). Impacts of ocean disposal of

municipal wastewater are discussed extensively in a collection of reviews edited by Myers and Harding (1983). Based on the general principle that changes in habitat engender changes in resident biota, it is expected that urbanization and other land use changes which result in modification of coastal and nearshore environments will have signficantly influenced Hawaii's marine resources.

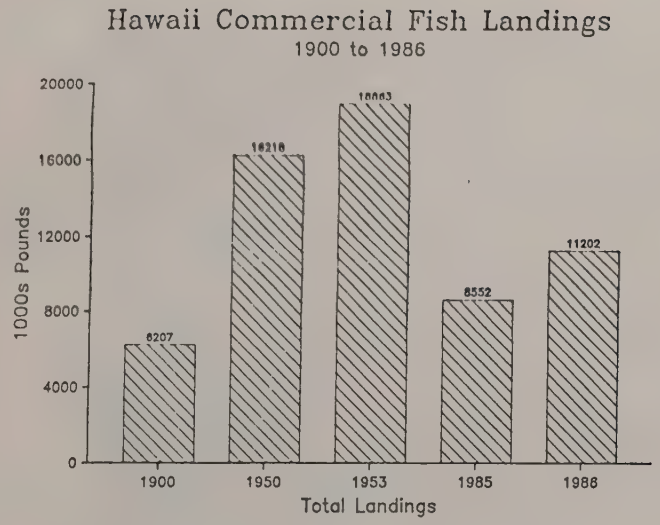
To provide some insight into possible changes that may have taken place in the coastal fishery resources of the MHI, a brief comparison can be made between commercial fishery statistics collected by the Territory of Hawaii in 1900 (Cobb 1902) and statistics collected by the Division of Aquatic Resources, State of Hawaii in 1985 (Table 1 and Fig. 1). Some dramatic differences appear between these two periods, especially when fishery landings are viewed for each type of resource habitat. A striking feature is the marked decrease in the catch of species associated with the nearshore waters, i.e., embayments, ponds, and reef areas (Fig. 2). The 1985 reported commercial marine fish catch is only 16% of that caught and sold in 1900. Although some of the decline can be attributed to the demise since 1900 of Hawaii's extensive fish pond culture system, the marked decline in catch of nearly all of the reported species suggests that other factors are involved.

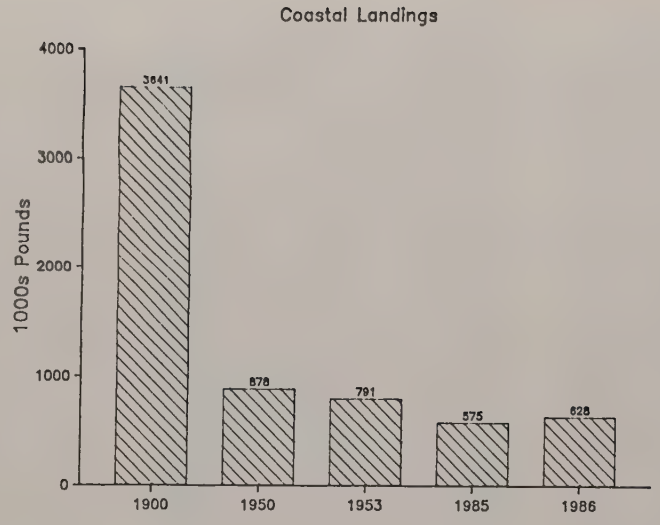
Table 1.-- Hawaii's commercial marine fish landings, 1900 and 1985.

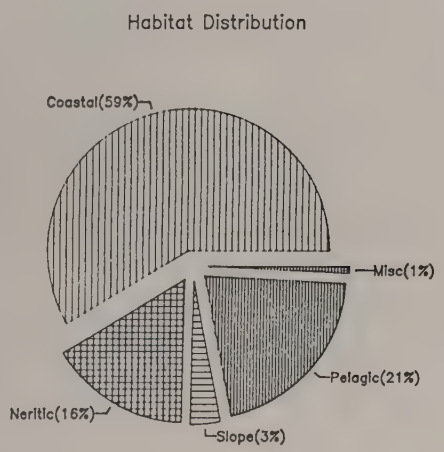
	Catch (thousand pounds) by year	
Habitat	1900[a]	1985[b]
Nearshore (embayment, pond, reef)	3,645	575
Neretic-pelagic (akule, opelu)	994	460
Slope and seamount	212	1,596
Pelagic	1,307	5,909
Miscellaneous	49	12
Total	6,207	8,552

[a]Cobb (1902).
[b]Hawaii Division of Aquatic Resources, unpublished annual report of commercial fish landings (1985).

In contrast to the nearshore resources, the catch of the offshore resources, e.g., slope-seamount and pelagic fishery complexes, has dramatically increased from 1900 to 1985. The catch of the slope and seamount category shows a 7.5-fold increase, while that of the pelagic category increased by 4.5-fold. One of the most likely factors responsible for this increase is the advent of motored fishing vessels in Hawaiian waters shortly after the turn of the century. Fishing in 1900 was from the shoreline or from canoes. In addition to fishing farther from shore, the motored vessels of recent years have incorporated navigational aids and hydraulic equipment to increase fishing depth and fishing efficiency.







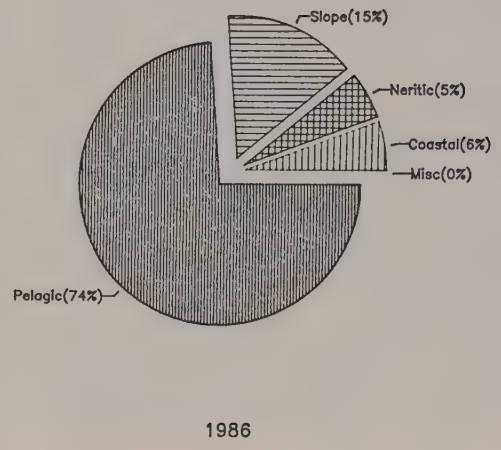


Figure 1.--Hawaii commercial marine fisheries catch, 1900-86.

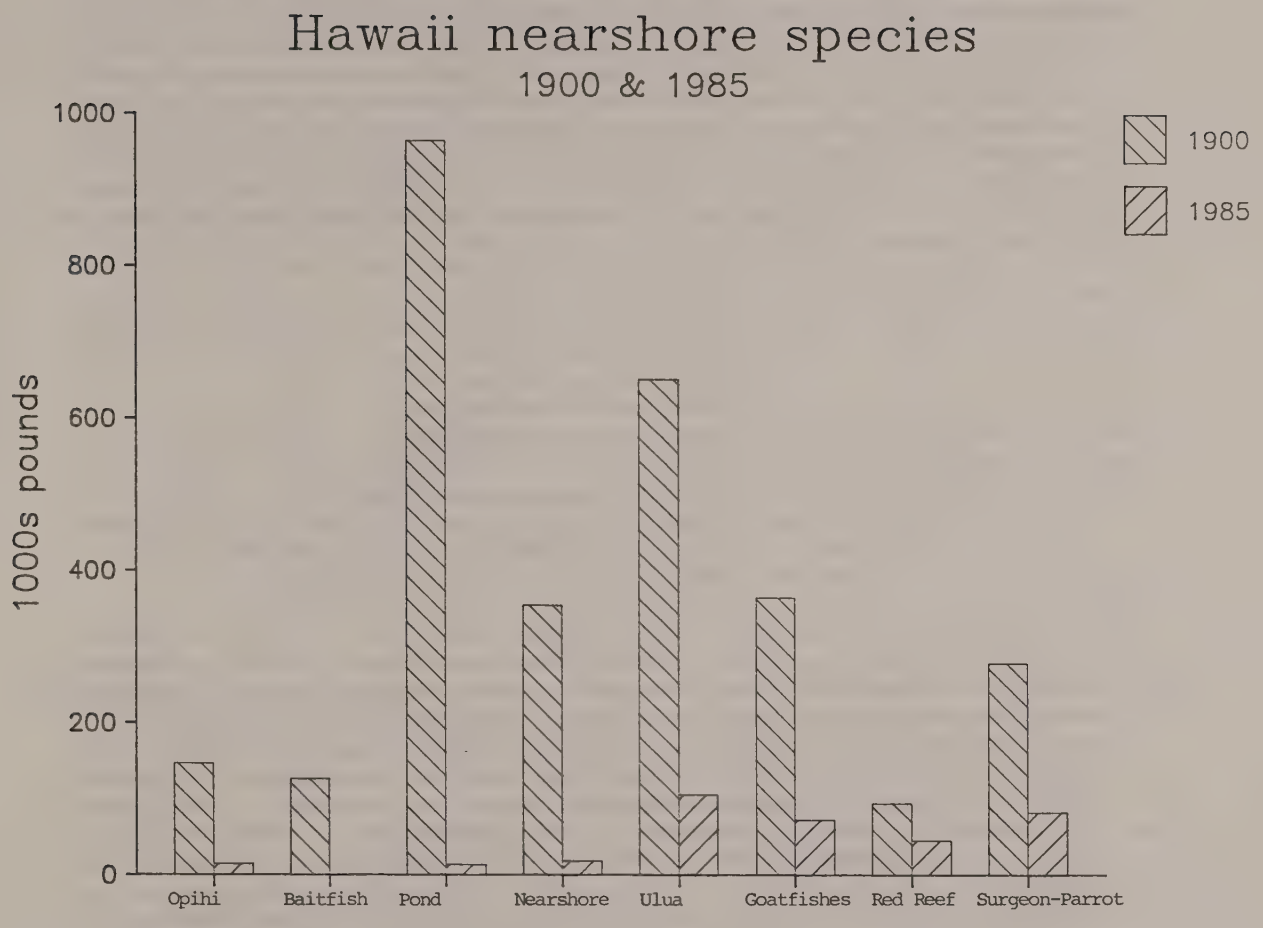


Figure 2.--Changes in commercial landings of nearshore species in Hawaii, 1900-85.

A general conclusion drawn from these comparisons of the past and present is that there is an urgent need to examine the current status of the marine fishery resources in the MHI waters. The dramatic decline of reported catch of coastal species may be attributed to short-comings in the current reporting system or to changes in fishing practices and target species. However, there is a strong possibility that overfishing and environmental changes are important causes of these declines (Fig. 3). Management decisions will depend greatly on identification of the major causative factors leading to these changes in the coastal marine resources of Hawaii and a basic scientific understanding of the biology of important fishery species.

- o Fishery pressure
- o Marine pollution
- o Ecosystem changes
- o Habitat alteration
- o Natural fluctuations
- o Competing marine uses

Figure 3.--Potential sources of change in Hawaii's marine resources and marine environment.

There are many potential causes for these changes in the abundance of Hawaii's living marine resources and in the quality of our marine environment, and there is a strong potential for further problems as Hawaii's population continues to grow and its economy continues to develop. These prospects are sufficient to warrant both **baseline assessments** and **issue-oriented analyses** of the basic natural processes of Hawaii's living marine resources and marine environment. These studies should contribute to a higher level of resource management in the MHI that should improve the quality of life for Hawaii's people and help resolve a number of current conflicts over the use of Hawaii's marine resources and environment. These studies should also contribute to other initiatives, which currently are addressing ocean use and coastal management in Hawaii.

II. Goals and objectives.

Three broad, overall goals are identified in this research initiative for studying the living marine resources and marine environment of the MHI.

I. To understand the basic biology and productivity of important living marine resources, particularly fishery resources,

II. to determine the impact of human activity and natural changes on the marine environment and living marine resources,

III. to develop management strategies for conserving and enhancing important living marine resources.

These goals contain a number of **specific objectives** (Table 2), which must also be met in an integrated scientific research program. These objectives are a selected, representative, high-priority sample of a wider list of objectives proposed (Pooley in prep.). Some of the top priority objectives are organized into a logical structure which identifies the kinds of "linkages" between them. This structure is shown in Figure 4 and described in the following paragraphs.

Early in the research process it will be important to identify the key biological problems (Goal I-6) which will motivate, and constrain, the research program. At the same time, development of basic data sources on environmental and living marine resources (Goal I-9), determination of the "practicality" of nearshore field research (Goal III-6), and preparation of an ocean ecosystem model (Goal I-7) are important inputs into the rest of the research initiative.

Then, a number of studies on living marine resource "life processes" will be undertaken in order to meet the overall objectives of Goal I. These are identified in the diagram as investigating basic life history information (Goals I-2,3), developing a food web model (Goal I-4), and ultimately determining the overall population structure of important living marine resources (Goal I-1).

The next step in the research initiative is to understand the changes which have occurred in living marine resource abundance and in marine environments. This will include studies on the impact of fisheries (Goal II-1), the impact of the nearshore environment on fisheries (Goal II-2), pollution (Goal II-6), coastal development (Goal II-7), and natural disturbances to the marine environment (Goal II-5). These form the basis for making an overall evaluation of the impact of human changes to our ocean resources (Goal II-4), developing a resource management model (Goal III-5), and evaluating alternative strategies for conserving and enhancing these living marine resources and the marine environment (Goals III-2,7).

III. Activities

To meet these goals and objectives a broad range of research activities is required. Six topical groups comprise the **activity fields** for this research, and these are linked to the overall goals which guide this initiative (Table 3). Table 4 lists a number of representative activities under each activity field. The detailed planning process which will be necessary to move this research initiative forward will identify other research activities and formulate them into research projects within the various agencies choosing to participate in this initiative.

A distinction among research activities can be made between experimental field and laboratory research, field surveys, and data base compilations and analysis. Each type of research activity has different requirements, although each could apply to any of the priority research goals and objectives. The role of project planning will be to choose which research methodologies best meet the needs within each research activity field.

Table 2.--**Goals and objectives for scientific research**--living marine resources and the marine environment of the main Hawaiian Islands (MHI).

I. To understand the basic biology and productivity of important living marine resources, particularly fishery resources.

1. Determine the productivity and overall population structure of important living marine resources.
2. Develop basic life history data for fishery management species.
3. Define early life history parameters, including habitat utilization and growth factors, for important species.
4. Develop a food web model of the MHI living marine community.
5. Determine the positive and negative interactions with other resource organisms for important living marine animals.
6. Identify living marine resources in fundamental biological trouble.
7. Synthesize existing oceanographic and biological data into a conceptual ecosystem model.
8. Determine the interrelationship between marine birds, the marine environment, and other living marine resources.
9. Develop a centralized, accessible data base on the marine environment and living marine resources.

II. To determine the impact of human activity and natural changes in the marine environment and living marine resources.

1. Determine the degree of exploitation of fishery resources.
2. Determine the linkages between fishing patterns and changes in the nearshore environment.
3. Model the impact of other human activities on changes in living marine resources and the marine environment.
4. Assess the ecological impacts of introduced species.
5. Determine the significance of catastrophic natural changes on marine habitat and the marine environment.
6. Assess comparative effects of pollution sources on living marine resources and environments.

Table 2.--Continued.

7. Identify the impact of cumulative development in coastal areas on marine resources and the marine environment.
8. Determine if threatened or endangered species are affected by human activity in using living marine resources and the environment.

III. To develop management strategies for conserving and enhancing important living marine resources.

1. Determine if changes in the abundance of living marine resources are reversible.

2. Assess the impact of marine reserves (closed areas) in enhancing fishery resources in those and adjacent areas.

3. Identify workable and cost-effective ways to restore productivity by improving habitats.

4. Investigate the ability of pollution degraded areas to recover following mitigation measures.

5. Establish a predictive model of management decisions and their effect in rehabilitating living marine resources and the marine environment.

6. Determine if real life practicalities preclude nearshore research.

    a. Identify areas suitable for restricted access to undertake field research.

7. Determine realistic sizes and timespans for reserved areas and closed seasons designed to enhance the recovery of living marine resources.

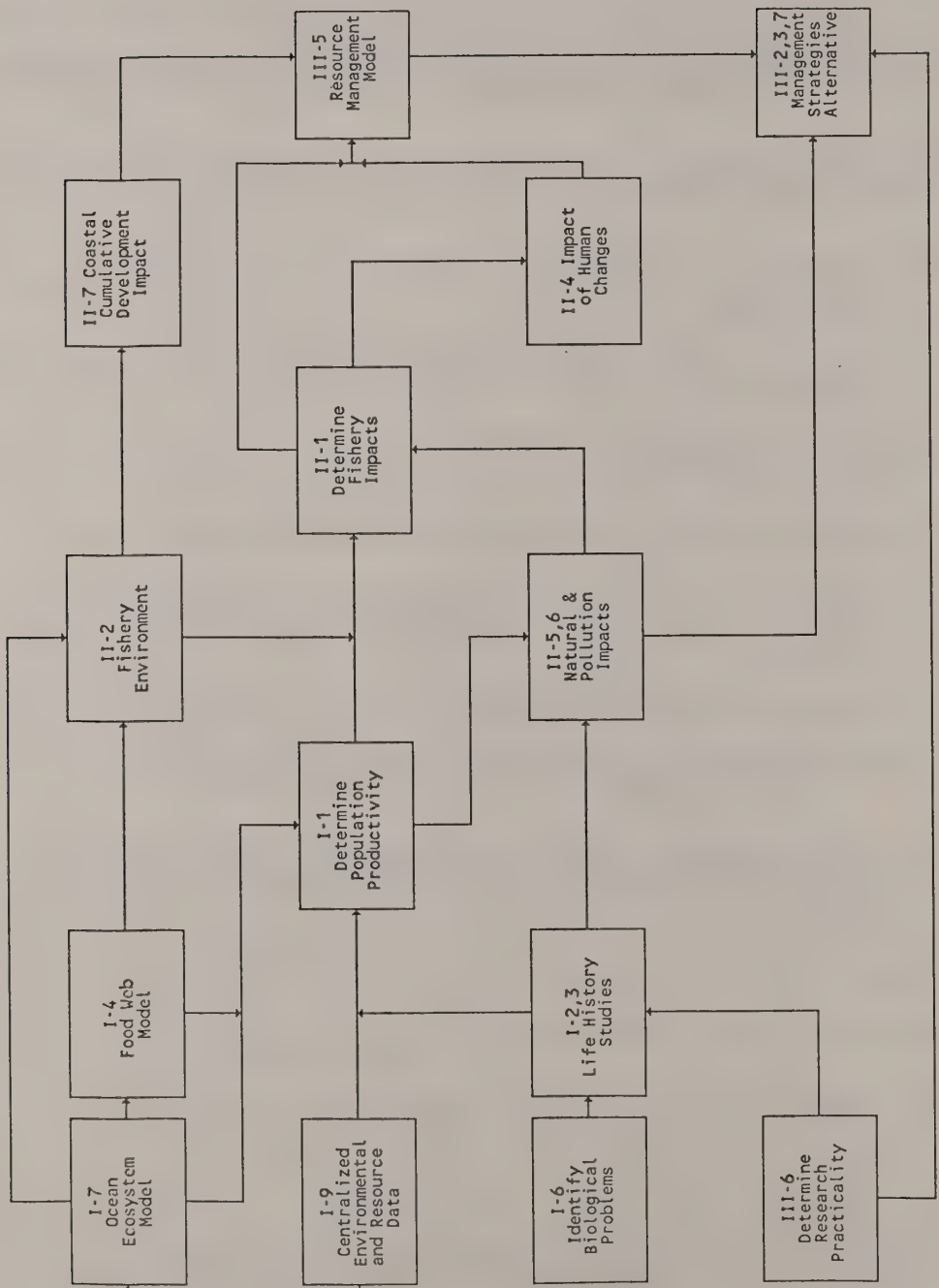

III-5 Resource Management Model
III-2,3,7 Management Strategies Alternative
II-7 Coastal Cumulative Development Impact
II-4 Impact of Human Changes
II-1 Determine Fishery Impacts
II-2 Fishery Environment
II-5,6 Natural & Pollution Impacts
I-1 Determine Population Productivity
I-4 Food Web Model
I-2,3 Life History Studies
I-7 Ocean Ecosystem Model
I-9 Centralized Environmental and Resource Data
I-6 Identify Biological Problems
III-6 Determine Research Practicality

Figure 4.--Linkages between some important main Hawaiian Island marine resources and environment research goals.

Table 3.--**Research activity fields and overall research goals.**

Goal I.	**To understand the basic biology and productivity of important living marine resources, particularly fishery resources**
	Activity field I-A: Marine research preparation
	Activity field I-B: Marine stock assessment studies
Goal II.	**To determine the impact of human activity and natural changes in the marine environment and living marine resources**
	Activity field II-A: Nearshore marine resource impact studies
	Activity field II-B: Marine pollution studies
	Activity field II-C: Marine resource and environment modeling
Goal III.	**To develop management strategies for conserving and enhancing important living marine resources**
	Activity field III-A: Living marine resource management studies
	Activity field III-B: Marine socio-economic studies
	Activity field III-C: Public marine awareness activities

Table 4.--Representative research activities.

Goal I. To understand the basic biology and productivity of important living marine resources, particularly fishery resources

Activity field I-A: Marine research preparation

-- Develop criteria for selection of resources and areas for research

-- Inventory important living marine resources communities and environmental areas

-- Prepare a time-series of environmental and biological data

-- Develop baseline data in coastal areas subject to development

-- Identify and reference available sources of biological and environmental data

-- Obtain commercial, recreational, and subsistence catch and effort data by gear type

Activity field I-B: Marine stock assessment studies

-- Document past declines and changes in living marine resources and quantify their causes

-- Undertake life history and population dynamics studies on major species

-- Determine causes of changes in catch per unit effort (commercial and sports fishing) and profile changes in fishing technology and methods

-- Investigate the use of FAD's (fish aggregating devices) as research and monitoring platforms

-- Conduct experiments to determine growth rates of important living marine species

Goal II. To determine the impact of human activity and natural changes on the marine environment and living marine resources

Activity field II-A: Nearshore Marine Resource Impact Studies

-- Undertake field studies to assess the comparative impacts of human and natural stresses to the nearshore ecosystem

-- Investigate the interactions of marine birds with fisheries and wetland habitats

Table 4.--Continued.

-- Determine the size and age structure of exploited compared to unexploited living marine resources

-- Conduct research into the effect of taape on the local ecosystem

-- Survey shallow and nearshore habitats for juvenile fish

__ Determine the basic biology of major nearshore invertebrate species (e.g., octopus, lobster, and shells) and the impact of harvesting and pollution on their abundance.

-- Assess alterations in marine resource community structures caused by habitat disturbances

-- Identify the role of fresh water input to the productivity of nearshore areas

-- Conduct field studies to determine the pathways of ciguatoxin in reef ecosystems

-- Define the range of movement of major ocean shelf species over daily, monthly and annual time scales (tag-release and tracking studies)

Activity field II-B: Marine pollution studies

-- Utilize major coastal and marine development projects as large scale environmental experiments

-- Quantify the pollutant content in living marine resources to compare stressed and unstressed areas

-- Compile data and conduct multivariate trend analysis on coastal water quality

-- Develop standard bioassay methods for acute and chronic levels of toxicity

-- Study the effect of ghost fishing on living marine resource communities

Activity field II-C: Marine resource and environment modeling

-- Create a general conceptual approach to trophic modeling in order to evaluate the adequacy of available data

-- Collect new data for trophic modeling

-- Construct a trophic model of the major biological components directly affecting nearshore fisheries

Table 4.--Continued.

-- Create a model of the nearshore environment at the marine ecosystem level (and test it in a selected area).

Goal III. To develop management strategies for conserving and enhancing important living marine resources

Activity field III-A: Living marine resource management studies

-- Collect information to determine how adverse trends in living marine resource abundance could be reversed

-- Compare productivity of marine life conservation areas with nonconservation areas

-- Investigate the effect of shoreline aqnd land use management on the nearshore environment

-- Collect data on application of existing marine resource management strategies

-- Evaluate human impacts in the marine environment on threatened and endangered species

Activity field III-B: Marine socio-economic studies

-- Determine the perceptions and changes in perceptions of the public concerning living marine resources and the marine environment

-- Estimate the use and "existence" value of living marine resources and environments

-- Evaluate the costs and benefits of marine resource and habitat enhancement projects

-- Evaluate the costs and benefits of marine resource management alternatives

Activity field III-C: Public Marine Awareness Activities

-- Provide educational resources on research issues, results and benefits

-- Determine the effectiveness of current marine resource and environmental law enforcement

IV. Program planning

Now is the time for action in both scientific research and resource management to enhance and restore Hawaii's living marine resources. However, for the research initiative to take effect, cooperation and funding from a number of important agencies are required. This document and the discussions which accompany it represent a major attempt by the scientific community to encourage that cooperation.

Our overall perspective is one of a collaborative research initiative in which the major State, Federal, University, and private research agencies of Hawaii, along with participation from the public, prepare a cooperative research plan to address specific issues in Hawaii's marine resources and environment. This planning document is oriented toward scientific issues and problems which need to be addressed in such an initiative.

The initiative is similar to the NWHI program which took place from 1976 to 1983. That research program (which is summarized in Appendix B) was successful in generating high quality scientific research, much of which was utilized in the development of the NWHI commercial fishery and by NWHI resource managers. The NWHI program was also extremely successful in developing working relationships between researchers of different agencies and departments, and among researchers and the public. This initiative, emphasizing the MHI, will be much more complex because of the high degree of everyday interaction between Hawaii's people and Hawaii's marine resources and environment. That is why this planning process began with an identification of important **living marine research goals and objectives** as a first step in developing an integrated program of resource management which must necessarily involve cooperation with the people who utilize Hawaii's marine resources and environment.

The overall research and management planning process might proceed as outlined in Figure 5.

The research program will begin as a 5-yr initiative with the knowledge that many activities will require a longer term of study for complete fieldwork, analysis, and presentation. However, the research program is oriented toward specific resource management actions. As a result, an initial review of management implications must be included in the research design, and it will be important to identify potential marine resource management possibilities early in the research process. We propose a symposium following 3 yr of research to review scientific results to date and propose interim approaches to management. The research program should be concluded with another symposium which would report results at the conclusion of the 5-yr research initiative and make more conclusive resource management recommendations. The research program should generate a proposal for ongoing base line and monitoring research. The resource management program should also involve public review of its results after several years. These ideas are outlined in Figure 6.

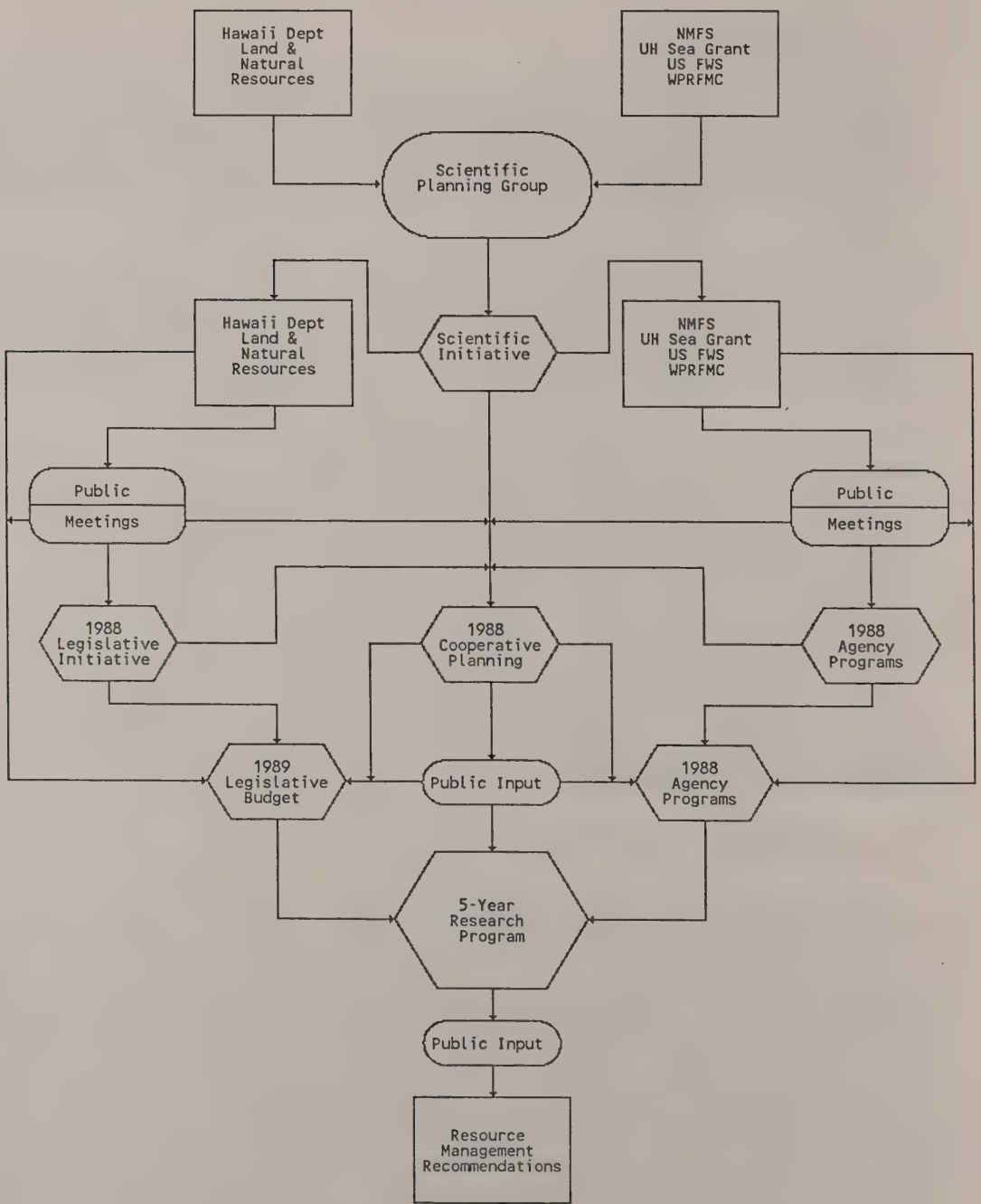


Figure 5.--Planning process for research program on main Hawaiian Islands marine resources and environment.

Year	Activity
1988	DLNR legislative initiative
	Development of UH Sea Grant initiative
	Cooperative agency program planning
	Public participation and input
1989	Agency programs and budgeting
	Initial research studies
1990	Preliminary management recommendations
	Research studies
1991	Research studies
1992	**Research symposium**
	Research studies
1993	Research studies
1994	**Research and management symposium**
1995	Management proposals to agencies
	Resource monitoring
	Ongoing research
2000	**Legislative review**

Figure 6.-- Time-frame for research program on the marine resources and environment of the main Hawaiian Islands.

An important issue will be the organization of the cooperative nature of the research initiative. Resolution of this issue has been left to the political process and the agencies, organizations, and individuals who cooperate in its implementation.

Any research initiative requires funding, usually funding beyond the base levels at which agencies are currently operating, and this initiative is no different. However, funding requests will be made by the individual agencies which participate in this research initiative, and no attempt has been made to estimate the overall cost. What is also required is a **cooperative** relationship among the participating agencies and the public, and a strong **public mandate** for this research initiative. Undoubtedly, new management measures and attempts at habitat enhancement will change some of the way we approach Hawaii's living marine resources and marine environment. This report represents the opening dialogue from the scientific community which urges a cooperative and informed approach toward these issues.

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Appendix A.--Scientific initiative planning group.

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Appendix B.--Summary of the Northwestern Hawaiian Islands resource investigations.

In 1975 a formal agreement was established between the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (FWS), and the Hawaii Division of Fish and Game (since renamed the Hawaii Division of Aquatic Resources (HDAR)). This agreement provided for a 5-yr survey and assessment of the marine resources of the Northwestern Hawaiian Islands, the islands and atolls ranging from Nihoa to Kure. This Tripartite Cooperative Agreement named NMFS as the lead agency and attributed responsibility for research on offshore, bank, and seamount resources to NMFS, nearshore resources to HDAR, and seabird resources to FWS. In 1977 the University of Hawaii, through its Sea Grant College Program, with matching funds assistance from the Hawaii Office of the Marine Affairs Coordinator, joined the study.

The major objective of the study was resource assessment and ecology for the purpose of protecting unique wildlife and managing potential fishery resources. During the study period, which concluded in 1983, the participating agencies attempted to maximize cooperative use of facilities and maintain open interagency communication.

A review symposium of preliminary results was held in 1980 at the University of Hawaii. Papers were given on 27 research projects. The papers from this symposium were published by the University of Hawaii Sea Grant Program (Grigg and Pfund 1980).

A final symposium of research results was held in 1983 at the University of Hawaii, and 39 research papers were presented. In addition, panel discussions were held with researchers, agency heads, and public participants, particularly commercial fishers and environmentalists. The results of this symposium were published in 1984 (Grigg and Tanoue 1984).

The range of studies included onshore and nearshore population studies, fishery resource assessments, ciguatera research, trophic relationships of nearshore fishes, life histories of important commercial fishing species, ecological and productivity studies of the marine habitat, analysis of the condition of threatened and endangered species, and economic, policy, and management studies.

The results consist inter alia of a series of management documents including one of the Natural Wildlife Refuge as a whole and a number of specific plans for commercial fisheries (FMP's for lobsters, bottom fishes, precious corals, and pelagics), and certain species of wildlife such as those which are threatened and/or endangered (Recovery plans for green turtles and monk seals). The results of the study include an encyclopedia of information on the marine resources of the NWHI that will undoubtably be relied upon for many years to come for a variety of problems dealing with questions of resource management.